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PROFILES – WP3:
Stakeholders Involvement and Interaction

PROFILES

Curricular Delphi Study on Science Education

Interim Report on the Second Round of the UP Working Group

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PROFILES

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1 Introduction

The overall objective of the PROFILES Curricular Delphi Study on Science Education is to engage different as many stakeholders as possible as experts in reflecting on contents and aims of science education in general as well as in outlining aspects and approaches of modern and desirable science education such as Inquiry Bases Science Education. The PROFILES Curricular Delphi Study on Science Education thus aims at illustrating contours of desirable science education in the opinions of different selected groups from society. The outcomes of this study will be used to prepare continuous teacher training courses (WP5) "aiding the implementation and dissemination of PROFILES ideas, intentions and objectives to facilitate the uptake of innovative science teaching and the enhancement of scientific literacy" (PROFILES Consortium, 2010, p. 20).

Hence, the main and general focus of the PROFILES Curricular Delphi Study on Science Education is on aspects of science education that are considered relevant and pedagogically desirable for the individual in the society of today and in the near future (Schulte & Bolte, 2011).

In the first interim report on the UP PROFILES Curricular Delphi Study on Science Education, the framework, aims, structure, concepts and methods of this study as well as the results from the first round of this study were introduced (Paiva, Morais & Barros, 2011).

The second round of the PROFILES Curricular Delphi Study on Science Education is about considering and reflecting – also critically – the findings from the first round which resulted from the analyses of the individually formulated responses of the participants. For this purpose and in accordance with the Delphi method, the categories that were established in the course of the analyses of the first round are fed back to the participants in the second round and combined with specific tasks and questions.

In this way, the findings from the first round are specified and concretized on the basis of the stakeholders' answers in the second round of this Delphi study (Bolte, 2003, 2007).

Subject of the second round is the identification of aspects and fields where priority and realization in science education practice drift apart in the opinions of the participants. Another subject of the second round is to identify – by means of cluster analyses – empirically based conceptions regarding desirable and contemporary science education that the participants consider as important and relevant.

The framework, the procedure and the results of the second round of the UP PROFILES Curricular Delphi Study on Science Education will be presented in this interim report.

2 Leading questions of the second round

A central aspect in the second round of the PROFILES Curricular Delphi Study on Science Education is addressing questions which resulted from the analyses in the first round (Bolte, 2003, 2008; Häußler, Frey, Hoffmann, Rost, & Spada, 1980; Linstone & Turoff, 1975; Mayer, 1992). In addition, the central questions of the PROFILES Curricular Delphi Study on Science Education are addressed as well in order to attain more differentiated and specified findings and insights. The second round considers therefore, amongst others, especially the following questions:

Part I:

- Which priorities regarding aspects of desirable science education can be derived from the participants' responses?
- To what extent are the respective aspects in the participants' opinions realized in science education practice?
- What kind of priority-practice differences can be identified in the participants' assessments?

Part II:

- What kind of empirically based conceptions regarding desirable and contemporary science education can be identified on the basis of the participants' statements?

With reference to the differentiations already administered in the first round, these questions are considered both regarding the total sample and the differences between the sample groups that are considered in the course of the PROFILES Curricular Delphi Study on Science Education (students, teachers, education researchers and scientists).

3 Design of the questionnaire and method of data analysis

Following the curricular Delphi method, we sent to all participants from the first round of the UP PROFILES Curricular Delphi Study on Science Education a two-part questionnaire with a list of categories regarding desirable science education that were identified in the course of the first round, the respective questions and a glossary with a description and explanation of the categories.

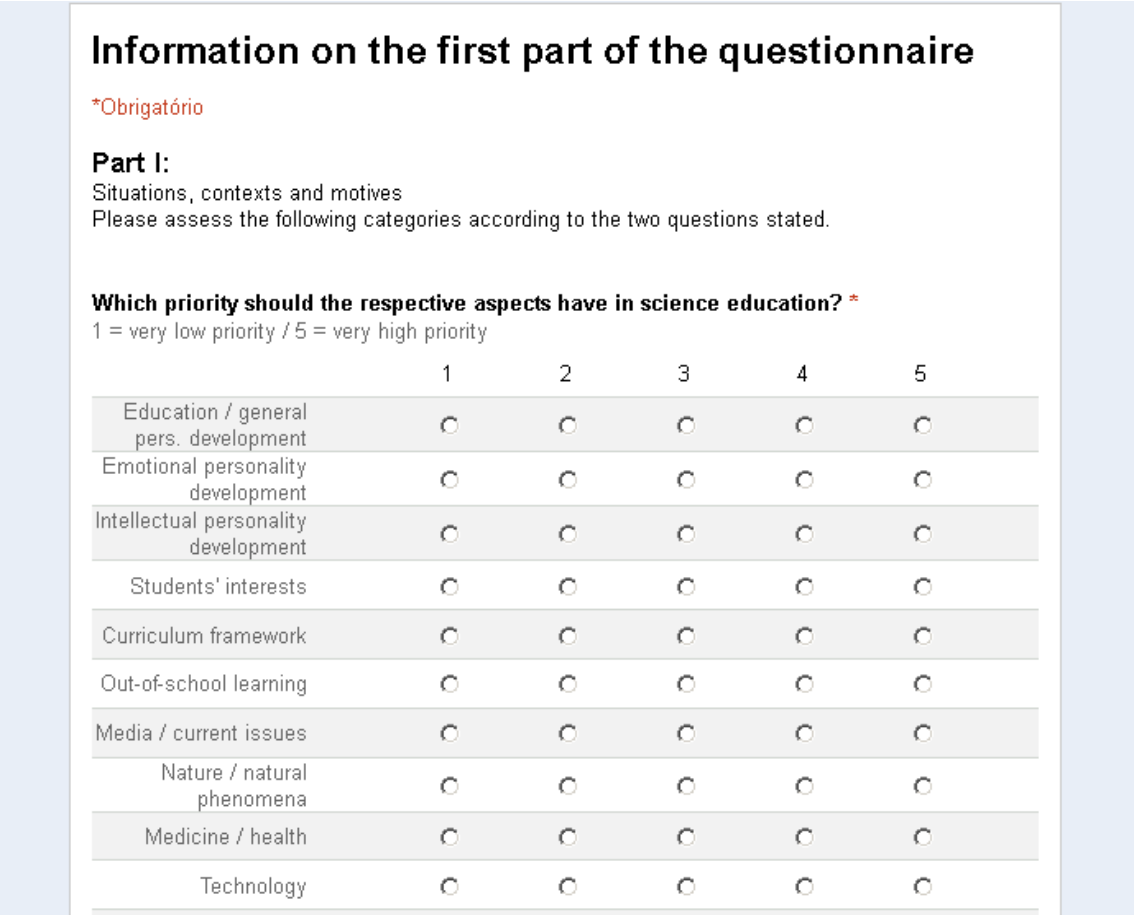
3.1 Questionnaire and data analysis of part I

In part I of round 2, the participants were asked to assess the categories established in the course of the first round analyses of the UP PROFILES Curricular Delphi Study on Science Education from two different perspectives. On the one hand they were asked to prioritize the given categories and on the other hand to assess to what extent the aspects expressed by the categories are realized in science education practice.

For the assessment of the categories, the participants were in part I of the questionnaire presented with a five-tier scale. The coding of the answers, following the five-tier scale, ranged from 1 to 5 (1: "very low priority" / "to a very low extent"; 2: "low priority" / "to a low extent"; 3: "rather middle priority" / "to a middle extent"; 4: "high priority" / "to a high extent"; 5: "very high priority" / "to a very high extent").

The questionnaire, part I**,** that UP PROFILES used in the Second Round of Delphi Study on Science Education is available online in https://docs.google.com/spreadsheet/viewform?formkey=dDB6VFhjVW02eDlKRld1MFRFWjdJRXc6MQ

The precise wording of the task, the questions and an example regarding the scale of part I of the questionnaire are shown in Figure 1.



Information on the first part of the questionnaire

*Obrigatório

Part I:
Situations, contexts and motives
Please assess the following categories according to the two questions stated.

Which priority should the respective aspects have in science education? *
1 = very low priority / 5 = very high priority

	1	2	3	4	5
Education / general pers. development	○	○	○	○	○
Emotional personality development	○	○	○	○	○
Intellectual personality development	○	○	○	○	○
Students' interests	○	○	○	○	○
Curriculum framework	○	○	○	○	○
Out-of-school learning	○	○	○	○	○
Media / current issues	○	○	○	○	○
Nature / natural phenomena	○	○	○	○	○
Medicine / health	○	○	○	○	○
Technology	○	○	○	○	○

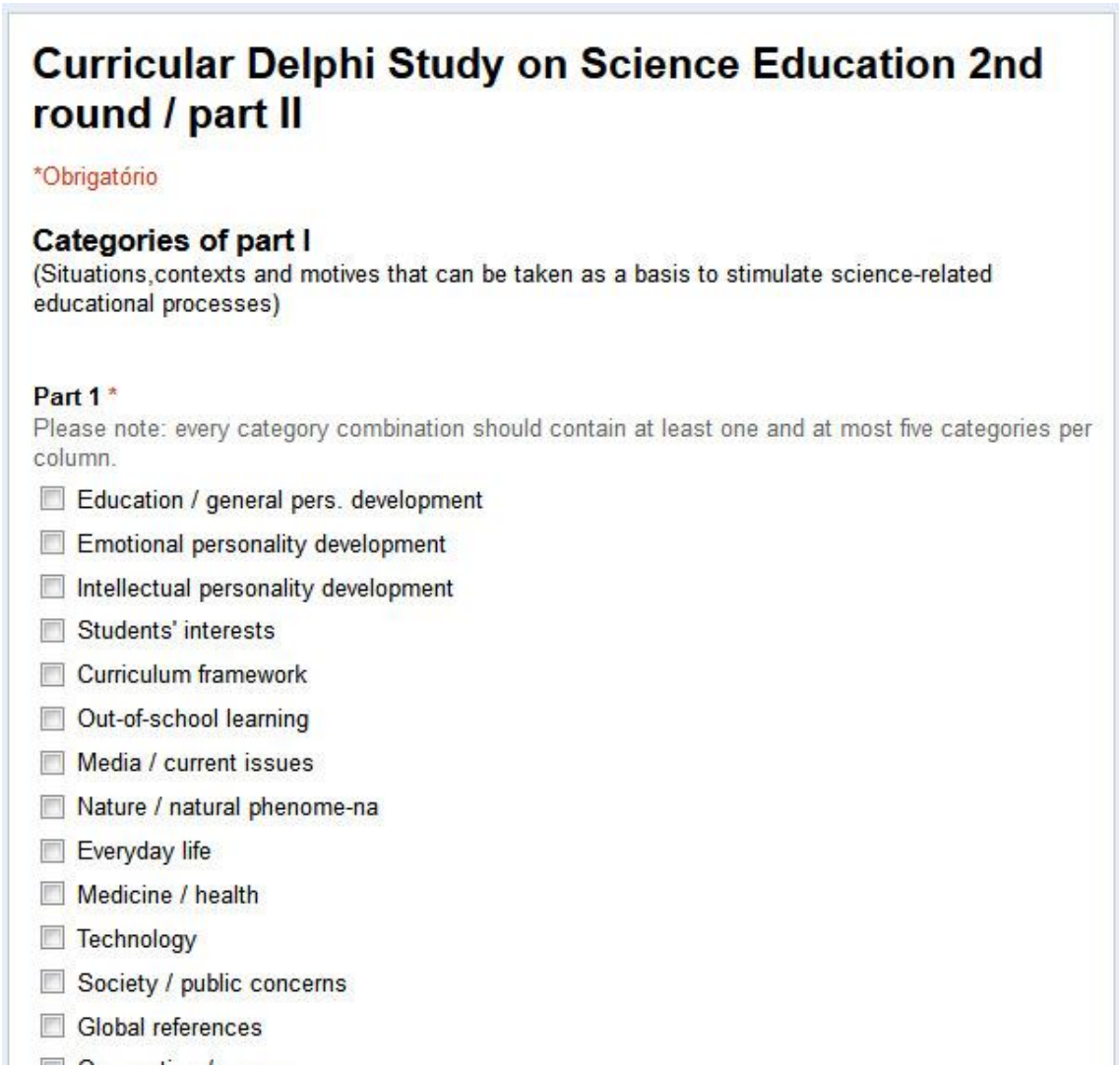
Figure 1: Extract from part I of the UP questionnaire of the second round available online.

The data in part I of the round 2 questionnaire was analyzed through descriptive and variance analytical methods. The analyses took into account both the priority and practice assessments individually as well as the priority-practice differences by subtracting the practice values from the priority values.

3.2 Questionnaire and data analyses of part II

As scientific literacy is a complex construct, its enhancement is thus not possible by referring to the different aspects only individually. Promoting scientific literacy is only possible if the complexity of the scientific literacy construct is accounted for in content, method and conception. Therefore, the empirically identified aspects need to be considered in relation to content, method and conception. The UP PROFILES Curricular Delphi Study on Science Education accounts for these considerations in part II of the second round.
In order to identify concepts regarding science education that are considered important, the participants were in part II of round 2 asked to combine from the given set of 80 categories those categories that seem especially important to them *in their combination*.
The questionnaire, part II**,** that UP PROFILES used in the Second Round of Delphi Study on Science Education is available online in https://docs.google.com/spreadsheet/viewform?formkey=dDlZOFdtSThjdjZsbVVPVHNXeGNLX0E6MQ

The precise wording of the task and the questions in part II of the questionnaire are shown in Figure 2.



Curricular Delphi Study on Science Education 2nd round / part II

*Obrigatório

Categories of part I
(Situations,contexts and motives that can be taken as a basis to stimulate science-related educational processes)

Part 1 *
Please note: every category combination should contain at least one and at most five categories per column.

- Education / general pers. development
- Emotional personality development
- Intellectual personality development
- Students' interests
- Curriculum framework
- Out-of-school learning
- Media / current issues
- Nature / natural phenome-na
- Everyday life
- Medicine / health
- Technology
- Society / public concerns
- Global references

Figure 2: Design of part II of the UP questionnaire of the second round available online.

The data of part II of the round 2 questionnaire was analyzed by means of hierarchical cluster analyses, using the Ward method and squared Euclidian distance.

4 Data collection and sample of the second round of the UP PROFILES Curricular Delphi Study on Science Education

As the Delphi method is based on a fixed group of participants throughout the different rounds (Linstone & Turoff, 1975), only the 86 stakeholders who participated in the first round of the UP PROFILES Curricular Delphi Study on Science Education were asked in written and electronic form to fill out the PROFILES Delphi questionnaire of the second round between March 2012 and May 2012.

Table 1 shows the UP sample structure and participation rate with regard to the drop-out between the first and the second round. It can be seen that out of the 86 participants from the first round, a total number of 54 participants (63% of the participants from the first round) took part in the second round.

Sample group		Number of responses		Participation rate	
		Round 1	Round 2		
Students		20	20	100%	
Teachers	Education Students	9	4	44%	
	Trainee teachers	1	1	100%	
	Science Teachers	28	25	89%	
	Teacher Educators	4	2	50%	
		38	32		71%
Education Researchers		2	1	50%	
Scientists		2	1	50%	
People who are not directly involved with sciences		20	0	0%	
Total		**86**	**54**	**63%**	

Table 1: Sample structure and response rate of the second round of the UP PROFILES Curricular Delphi Study

It can also be seen that, with a response rate of 100%, all participants from the first round in the group of *Students* also took part in the second round. The participation rate in the group of *Education Researchers* and *Scientists* decreased for an half (50%) in comparison with the participants in the first round. Due to drop-out in the sub-samples, the group of *Teachers* features a participation rate of 71%. The highest drop-out between the first and the second round took place in the sub-sample of *Education Students* with a response rate of 44%. The lowest drop-out between the first and the second round took place in the sub-sample of *Science Teachers* with a response rate of 89%. The overall response rate of 63 % for the total sample and the remaining sample size for round 2 are satisfying (in comparison with the first round).

A detailed overview of the sample structure of the second round of the UP Curricular Delphi Study on Science Education is shown in Table 2.

Sample group		Total number		Percentage
Students	Students at school without advanced science courses	10	20	37%
	Students at school with advanced sciences courses	10		
Teachers	Education Students	4	32	59, 3%
	Trainee teachers	1		
	Science Teachers	25		
	Teacher Educators	2		
Education Researchers		1		1,9%
Scientists		1		1,9%
Total		54		100%

Table 2: Detailed sample structure of the second round of the UP Curricular Delphi Study on Science Education.

The total number of subjects was 54. Of this, with a number of 32 participants, the group of *teachers* makes up a total of 59, 3%. The group of *students* consists of 20 participants altogether, constituting the second largest group of the sample (37%). The next groups were significantly smaller, with the *education researchers* group and *scientists* groups having both only 1 respondent (1,9%).

5 Results

5.1 Results Part I

In the following parts, selected results from the descriptive-statistical analyses with regard to the priority assessments are shown. The descriptive and variance-statistical analyses were made on the data basis of the four different sample groups (students, teachers, educators and scientists). The following descriptions will focus on the responses of the total sample as well as on the different sample groups. It's important to underline that we didn´t include the groups of science education researchers and scientists in the comparison because we had a very low participation rate in the groups. So this fact justifies why there are only the two groups in the comparison that can be seen in the following pages.

5.1.1 - Priority assessments of the total sample and the different sample groups

First of all, the Table 3 shows the first details of priority assessments among the whole sample. This table shows the 10 categories with highest and lowest mean values in descending order, considering all the participants across all groups.

Priority Assessment		
Categories	**Mean values**	**Std. Deviation**
Analysing / drawing conclusions	4,62	,745
Motivation and interest	4,50	,728
Applying knowledge, thinking creatively / abstractly	4,48	,700
Experimenting	4,48	,754
Working self-dependently / structuredly	4,46	,670
Critical questioning	4,46	,828
Judgement /opinion-forming / reflection	4,46	,670
Comprehension / understanding	4,44	,752
Science - chemistry	4,42	,723
Acting reflectedly and responsibly	4,40	,774
…		
Astronomy / space system	3,71	,825
History of the sciences	3,69	,781
Thermodynamics	3,65	,814
Electrodynamics	3,63	,886
Learning at stations	3,62	,911
Role play	3,52	1,057
Zoology	3,46	,851
Emotional personality development	3,42	1,091
Botany	3,25	,883
Learning in mixed-aged classes	3,17	1,150

Table 3: Highest and lowest priority assessment means.

The highest mean value with regard to the priority the participants assigned to this aspect appears with the category “Analysing/Drawing conclusions” (mean value = 4,62). Considering the top ten categories, it can be noted that they refer to aspects rather related to everyday life and general education and skills. The lowest mean values appear associated with natural sciences and three learning methods, with the category “Learning in mixed-aged classes” appearing at the bottom (mean value = 3,17).

The next tables (Table 4 to Table 8) show the mean values of the different sample groups, followed by the comparisons and the respective significance values (independent sample T-test). The suggested inclusion of a new group *adults* didn’t yell any different significance values to the displayed comparisons so it was subsided. Due to the nature of the sample, both the *Scientists* and *Education Researchers* group were left out of the analysis, leaving a simple comparison between *Teachers* (n = 32) and *Students* (n = 20).

Only the significant test values indicating statistically significant differences are displayed ($p<.05$). The tables are divided into different parts according to the different parts of the category system: contexts, motives and situations (Table 4), basic concepts and topics (Table 5), fields and perspectives (Table 6), qualifications (Table 7), and methods (Table 8).

Apart from some exceptions, it can be seen that the different sample groups generally consider the same categories as relevant and important. However, as the tables also show, the mean values differ in a number of pair comparisons among the sample groups in a statistically significant way from each other.

Categories regarding contexts, motives and situations	Group	Sig. Values	Mean values	Std. Deviation
Education / general pers. development	Students	-	4,35	,745
	Teachers		4,28	,634
Emotional personality development	Students	-	3,70	,923
	Teachers		3,25	1,164
Intellectual personality development	Students	-	4,10	,718
	Teachers		4,56	,619
Students' interests	Students	-	4,10	1,071
	Teachers		4,16	,767
Curriculum framework	Students	-	3,95	,826
	Teachers		3,72	,581
Out-of-school learning	Students	-	3,65	,813
	Teachers		4,16	,847
Media / current issues	Students	-	3,85	,745
	Teachers		3,69	,738
Nature / natural phenomena	Students	-	3,60	,883
	Teachers		4,41	,665
Medicine / health	Students	-	4,40	,821
	Teachers		4,00	,718
Technology	Students	-	3,80	,894
	Teachers		4,03	,740
Everyday life	Students	-	3,65	1,226
	Teachers		4,38	,793
Society / public concerns	Students	-	3,75	1,372
	Teachers		3,84	,808
Global references	Students	-	3,85	,813
	Teachers		3,88	,751
Occupation / career	Students	-	4,00	1,026
	Teachers		3,84	,884
Science - biology	Students	-	4,25	,851
	Teachers		4,41	,615
Science - chemistry	Students	-	4,05	,826
	Teachers		4,66	,545
Science - physics	Students	-	4,05	,759
	Teachers		4,63	,554
Science - interdisciplinarity	Students	-	4,15	,587
	Teachers		4,34	,745

Table 4: Mean and significance values regarding the priority assessment between groups concerning contexts, motives and situations.

Categories regarding basic concepts and topics	Group	Sig. Values	Mean values	Std. Deviation
Matter / particle concept	Students	-	3,90	,912
	Teachers		4,28	,634
Structure / function / properties	Students	-	3,80	,894
	Teachers		4,19	,592
Chemical reactions	Students	-	3,85	,745
	Teachers		4,31	,644
Energy	Students	-	4,20	,768
	Teachers		4,28	,729
System	Students	-	4,10	,718
	Teachers		3,81	,738
Interaction	Students	-	4,20	,696
	Teachers		3,84	,987
Development / growth	Students	-	4,15	,745
	Teachers		3,66	,937
Models	Students	-	3,60	,995
	Teachers		4,00	,718
Terminology	Students	-	3,55	,945
	Teachers		4,03	,647
Scientific inquiry	Students	-	3,95	,759
	Teachers		4,41	,665
Limits of scientific knowledge	Students	-	4,15	,933
	Teachers		4,09	,856
Cycle of matter	Students	-	4,00	,858
	Teachers		3,84	,574
Food / nutrition	Students	-	4,10	,912
	Teachers		3,88	,793
Health / medicine	Students	-	4,35	,875
	Teachers		3,88	,707
Matter in everyday life	Students	-	3,95	,887
	Teachers		4,34	,602
Environment	Students	-	3,95	1,050
	Teachers		4,38	,660
Industrial processes	Students	-	3,80	,834
	Teachers		3,84	,723
Safety and risks	Students	-	3,90	1,071
	Teachers		4,19	,780
Occupations / occupational fields	Students	-	4,00	,795
	Teachers		3,75	,718

Table 5: Mean and significance values regarding the priority assessment between groups concerning basic concepts and topics.

Categories regarding fields and perspectives	Group	Sig. Values	Mean values	Std. Deviation
Botany	Students	-	3,00	,858
	Teachers		3,41	,875
Zoology	Students	-	3,55	,826
	Teachers		3,41	,875
Human biology	Students	-	4,40	,754
	Teachers		4,31	,644
Genetics / molecular biology	Students	-	4,40	,681
	Teachers		4,09	,689
Microbiology	Students	**-**	4,05	,826
	Teachers		3,53	,879
Evolutionary biology	Students	-	4,10	,852
	Teachers		3,63	1,040
Neurobiology	Students	-	4,10	,788
	Teachers		3,75	1,047
Ecology	Students	-	3,80	1,152
	Teachers		4,28	,813
Gereral and inorganic chemistry	Students	-	3,80	,696
	Teachers		4,19	,644
Organic chemistry	Students	-	3,85	,813
	Teachers		4,00	,762
Analytical Chemistry	Students	-	3,65	1,089
	Teachers		3,94	,878
Biochemistry	Students	-	4,10	,852
	Teachers		4,03	1,031
Thermodynamics	Students	-	3,65	,745
	Teachers		3,66	,865
Electrodynamics	Students	-	3,60	,883
	Teachers		3,66	,902
Mechanics	Students	**-**	3,65	1,089
	Teachers		4,34	,701
Atomic / nuclear physics	Students	-	3,75	,910
	Teachers		3,91	,963
Astronomy / space system	Students	-	3,65	,813
	Teachers		3,75	,842
Earth sciences	Students	-	4,05	,759
	Teachers		4,19	,821
Mathematics	Students	-	4,05	,826
	Teachers		4,41	,615
Interdisciplinarity	Students	-	4,15	,813
	Teachers		4,56	,759
Current scientific research	Students	-	4,25	,851
	Teachers		4,28	,729
Consequences of technological developments	Students	-	4,25	1,020
	Teachers		4,28	,813
History of the sciences	Students	-	3,70	,801
	Teachers		3,69	,780
Ethics / values	Students	-	4,25	,967
	Teachers		4,38	,833

Table 6: Mean and significance values regarding the priority assessment between groups concerning fields and perspectives.

Categories regarding qualifications	Group	Sig. Values	Mean values	Std. Deviation
Motivation and interest	Students	-	4,30	,865
	Teachers		4,63	,609
Critical questioning	Students	-	4,20	1,105
	Teachers		4,63	,554
Acting reflectedly and responsibly	Students	-	4,15	,933
	Teachers		4,56	,619
Knowledge about science-related occupations	Students	-	3,90	,788
	Teachers		3,97	,782
Specialized knowledge	Students	-	3,85	,671
	Teachers		3,75	,622
Comprehension / understanding	Students	-	4,20	,951
	Teachers		4,59	,560
Applying knowledge, thinking creatively / abstractly	Students	-	4,25	,851
	Teachers		4,63	,554
Judgement /opinion-forming / reflection	Students	-	4,30	,733
	Teachers		4,56	,619
Finding information	Students	-	4,10	,553
	Teachers		4,41	,665
Reading comprehension	Students	-	4,05	,686
	Teachers		4,47	,671
Communication skills	Students	-	3,95	,826
	Teachers		4,09	,734
Social skills / teamwork	Students	-	3,85	,813
	Teachers		4,34	,653
Empathy / sensibility / emotional skills	Students	-	3,85	,875
	Teachers		3,91	,893
Perception / awareness / observation	Students	-	4,10	,852
	Teachers		4,28	,729
Formulating scientific questions / hypotheses	Students	-	4,00	,918
	Teachers		4,63	,609
Experimenting	Students	-	4,20	,894
	Teachers		4,66	,602
Analysing / drawing conclusions	Students	-	4,30	,979
	Teachers		4,81	,471
Working self-dependently / structuredly	Students	-	4,20	,696
	Teachers		4,63	,609

Table 7: Mean and significance values regarding the priority assessment between groups concerning qualifications.

Categories regarding methods	Group	Sig. Values	Mean values	Std. Deviation
Cooperative Learning	Students	-	4,00	,973
	Teachers		4,25	,672
Learning in mixed-aged classes	Students	-	3,25	1,070
	Teachers		3,13	1,212
Interdisciplinary learning	Students	-	4,05	,826
	Teachers		4,22	,608
Inquiry-based science learning	Students	-	3,90	,788
	Teachers		4,53	,621
Learning at stations	Students	-	3,45	,887
	Teachers		3,72	,924
Role play	Students	-	3,75	1,209
	Teachers		3,38	,942
Discussion / debate	Students	-	3,95	1,099
	Teachers		4,09	,734
Using new media	Students	-	4,00	,973
	Teachers		4,03	,740

Table 8: Mean and significance values regarding the priority assessment between groups concerning methods.

5.1.2 - Practice assessments of the total sample and the different sample groups

Once again, the next Table shows the first details of priority assessments among the whole sample. This table shows the 10 categories with highest and lowest mean values in descending order.

Practice Assessment		
Categories	**Mean values**	**Std. Deviation**
Mathematics	4,15	,937
Matter / particle concept	3,98	,852
Energy	3,94	,873
Human biology	3,92	,882
Science - physics	3,88	,922
Science - biology	3,83	,923
Chemical reactions	3,81	,864
Science - chemistry	3,81	,908
Structure / function / properties	3,77	,731
Environment	3,73	,952
…		
Occupations / occupational fields	3,02	,939
Occupation / career	2,98	1,213
Society / public concerns	2,98	1,038
Empathy / sensibility / emotional skills	2,98	1,093
History of the sciences	2,92	1,082
Biochemistry	2,90	1,071
Neurobiology	2,83	1,080
Emotional personality development	2,79	1,054
Role play	2,63	1,172
Learning in mixed-aged classes	2,59	1,321

Table 9: Highest and lowest practice assessment means.

The highest mean value with regard to practice assessment by the participants appears with the category “Mathematics” (mean value = 4,15). Considering the top ten categories, it can be noted that they refer to basic concepts and specialized fields, showing that the teaching

strategies focus strongly on the content, rather than the method. Confirming this, we see the lowest mean values appear associated with learning methods, with the category “Learning in mixed-aged classes” appearing at the bottom again (mean value = 2,59).

The following tables show once again a comparison of the mean values of the different sample groups and the respective significance regarding the comparisons of the mean values in the different sample groups. The previous constraints apply.

At a quick glance, the category which presents the largest number of differences concerns is the “Qualifications”. It seems this is the area where teachers and students most disagree.

Only the significant test values indicating statistically significant differences are displayed ($p<.05$). The tables are divided into different parts according to the different parts of the category system: contexts, motives and situations (Table 10), basic concepts and topics (Table 11), fields and perspectives (Table 12), qualifications (Table 13) and methods (Table 14).

Categories regarding contexts, motives and situations	Group	Sig. Values	Mean values	Std. Deviation
Education / general pers. development	Students	**.003**	3,95	,999
	Teachers		3,16	,808
Emotional personality development	Students	-	3,25	1,118
	Teachers		2,50	,916
Intellectual personality development	Students	**.011**	3,45	1,146
	Teachers		3,41	,712
Students' interests	Students	-	3,15	1,226
	Teachers		2,97	,999
Curriculum framework	Students	-	3,55	,999
	Teachers		3,81	,896
Out-of-school learning	Students	**-**	3,25	1,372
	Teachers		2,91	,928
Media / current issues	Students	-	3,30	1,174
	Teachers		3,06	,801
Nature / natural phenomena	Students	**-**	3,75	,967
	Teachers		3,59	,712
Medicine / health	Students	-	3,95	,999
	Teachers		3,13	,793
Technology	Students	-	3,35	1,040
	Teachers		3,81	,859
Everyday life	Students	**-**	3,65	1,182
	Teachers		3,22	,792
Society / public concerns	Students	**.041**	3,35	1,089
	Teachers		2,75	,950
Global references	Students	**.003**	3,80	1,056
	Teachers		3,00	,803
Occupation / career	Students	**<.001**	3,70	1,129
	Teachers		2,53	1,047
Science - biology	Students	-	4,00	,918
	Teachers		3,72	,924
Science - chemistry	Students	**-**	3,90	,912
	Teachers		3,75	,916
Science - physics	Students	**-**	4,10	,912
	Teachers		3,75	,916
Science - interdisciplinarity	Students	**.001**	3,75	,967
	Teachers		2,81	,965

Table 10: Mean and significance values regarding the practice assessment between groups concerning contexts, motives and situations.

Categories regarding basic concepts and topics	Group	Sig. Values	Mean values	Std. Deviation
Matter / particle concept	Students	-	3,95	,759
	Teachers		4,00	,916
Structure / function / properties	Students	-	3,80	,768
	Teachers		3,75	,718
Chemical reactions	Students	-	3,80	,951
	Teachers		3,81	,821
Energy	Students	-	3,95	,826
	Teachers		3,94	,914
System	Students	-	3,75	,786
	Teachers		3,31	,965
Interaction	Students	-	3,95	,945
	Teachers		3,47	,803
Development / growth	Students	**.015**	3,55	,945
	Teachers		2,88	,942
Models	Students	-	3,50	,946
	Teachers		3,31	,896
Terminology	Students	-	3,45	,945
	Teachers		3,72	,991
Scientific inquiry	Students	**.043**	3,60	,940
	Teachers		2,94	1,216
Limits of scientific knowledge	Students	**.025**	3,50	1,147
	Teachers		2,75	1,136
Cycle of matter	Students	-	3,55	,826
	Teachers		3,34	,701
Food / nutrition	Students	-	3,40	,995
	Teachers		2,91	,893
Health / medicine	Students	**<.001**	4,00	,918
	Teachers		2,97	,933
Matter in everyday life	Students	**.025**	3,75	,851
	Teachers		3,19	,859
Environment	Students	-	3,95	1,050
	Teachers		3,59	,875
Industrial processes	Students	**.027**	3,50	1,000
	Teachers		2,84	1,019
Safety and risks	Students	**.037**	3,80	1,056
	Teachers		3,19	,965
Occupations / occupational fields	Students	**.003**	3,50	1,000
	Teachers		2,72	,772

Table 11: Mean and significance values regarding the practice assessment between groups concerning basic concepts and topics.

Categories regarding fields and perspectives	Group	Sig. Values	Mean values	Std. Deviation
Botany	Students	-	3,30	,979
	Teachers		3,28	,924
Zoology	Students	-	3,40	,883
	Teachers		3,13	1,008
Human biology	Students	-	4,15	,875
	Teachers		3,78	,870
Genetics / molecular biology	Students	**.002**	3,95	,945
	Teachers		3,16	,767
Microbiology	Students	**.004**	3,55	,945
	Teachers		2,72	,958
Evolutionary biology	Students	**.006**	3,55	,945
	Teachers		2,81	,859
Neurobiology	Students	**.005**	3,35	,813
	Teachers		2,50	1,107
Ecology	Students	-	3,45	,945
	Teachers		3,53	,842
Gereral and inorganic chemistry	Students	-	3,35	,813
	Teachers		3,53	,950
Organic chemistry	Students	-	3,35	,988
	Teachers		3,41	,946
Analytical Chemistry	Students	-	3,35	1,137
	Teachers		3,22	,832
Biochemistry	Students	**.001**	3,50	1,100
	Teachers		2,53	,879
Thermodynamics	Students	**-**	3,40	1,273
	Teachers		3,16	1,051
Electrodynamics	Students	**.050**	3,45	1,276
	Teachers		2,78	1,099
Mechanics	Students	**-**	3,35	1,309
	Teachers		3,72	1,023
Atomic / nuclear physics	Students	-	3,65	,988
	Teachers		3,25	1,078
Astronomy / space system	Students	-	3,70	,865
	Teachers		3,50	,916
Earth sciences	Students	-	3,80	,834
	Teachers		3,47	,803
Mathematics	Students	**<.001**	3,60	1,046
	Teachers		4,50	,672
Interdisciplinarity	Students	**.016**	3,65	,988
	Teachers		2,91	1,088
Current scientific research	Students	**.038**	3,45	1,099
	Teachers		2,78	1,099
Consequences of technological developments	Students	-	3,45	1,276
	Teachers		3,13	1,040
History of the sciences	Students	**.011**	3,40	1,142
	Teachers		2,63	,942
Ethics / values	Students	-	3,45	1,356
	Teachers		2,84	,954

Table 12: Mean and significance values regarding the practice assessment between groups concerning fields and perspectives.

Categories regarding qualifications	Group	Sig. Values	Mean values	Std. Deviation
Motivation and interest	Students	-	3,70	1,174
	Teachers		3,25	1,164
Critical questioning	Students	**.028**	3,75	1,251
	Teachers		3,00	1,107
Acting reflectedly and responsibly	Students	**.016**	3,85	1,182
	Teachers		2,91	1,146
Knowledge about science-related occupations	Students	**.001**	3,90	1,071
	Teachers		2,88	1,008
Specialized knowledge	Students	**.008**	3,65	,933
	Teachers		2,91	,963
Comprehension / understanding	Students	-	3,70	1,031
	Teachers		3,16	1,019
Applying knowledge, thinking creatively / abstractly	Students	**.001**	3,75	1,118
	Teachers		2,72	1,023
Judgement /opinion-forming / reflection	Students	**.002**	3,75	,910
	Teachers		2,69	1,230
Finding information	Students	**.002**	4,00	,918
	Teachers		3,06	1,045
Reading comprehension	Students	**.019**	3,90	,718
	Teachers		3,28	,991
Communication skills	Students	**.027**	3,65	1,182
	Teachers		2,94	1,045
Social skills / teamwork	Students	**-**	3,45	1,191
	Teachers		3,00	1,107
Empathy / sensibility / emotional skills	Students	**.027**	3,40	1,142
	Teachers		2,72	,991
Perception / awareness / observation	Students	**.032**	3,70	,801
	Teachers		3,13	,976
Formulating scientific questions / hypotheses	Students	**.015**	3,65	,988
	Teachers		2,88	1,129
Experimenting	Students	**-**	3,55	1,099
	Teachers		3,47	,950
Analysing / drawing conclusions	Students	**.017**	3,85	,988
	Teachers		3,16	,987
Working self-dependently / structuredly	Students	**.028**	3,65	1,040
	Teachers		3,00	,984

Table 13: Mean and significance values regarding the practice assessment between groups concerning qualifications.

Categories regarding methods	Group	Sig. Values	Mean values	Std. Deviation
Cooperative Learning	Students	-	3,50	1,147
	Teachers		3,13	1,070
Learning in mixed-aged classes	Students	-	2,95	1,234
	Teachers		2,25	1,320
Interdisciplinary learning	Students	**.026**	3,45	,999
	Teachers		2,78	1,039
Inquiry-based science learning	Students	**.009**	3,75	,716
	Teachers		2,94	1,216
Learning at stations	Students	-	3,25	1,070
	Teachers		2,97	1,121
Role play	Students	**.042**	3,05	1,234
	Teachers		2,38	1,070
Discussion / debate	Students	-	3,30	,801
	Teachers		2,97	1,121
Using new media	Students	**.034**	3,80	1,056
	Teachers		3,13	1,100

Table 14: Mean and significance values regarding the practice assessment between groups concerning methods.

5.1.3 - Priority-practice differences of the total sample and the different sample groups

In this part, selected results from the descriptive-statistical analyses with regard to the priority-practice differences (PPD) are shown. The priority-practice differences result from subtracting the practice values from the priority values (xP-xR = ΔPPD). The following passages will focus on the description and comparison of results regarding the total sample as well as different groups.

First, special attention will be paid to those aspects that feature particularly large or small differences between the assessments of their priority and their actual realization in educational practice because these extreme difference values inform about especially big or small discrepancy between priority and reality.
The calculated priority-practice differences show that many categories feature large differences between their priority and practice values. In order to illustrate the spectrum of this observation, the next table displays the ten highest and ten lowest priority-practice differences in the total sample.

Priority-Practice Difference		
Categories	**Mean values**	**Std. Deviation**
Applying knowledge, thinking creatively / abstractly	1,41	1,447
Judgement /opinion-forming / reflection	1,30	1,525
Interdisciplinarity	1,28	1,309
Current scientific research	1,24	1,273
Working self-dependently / structuredly	1,20	1,088
Interdisciplinary learning	1,19	1,245
Formulating scientific questions / hypotheses	1,15	1,485
Science - interdisciplinarity	1,15	1,219
Analysing / drawing conclusions	1,15	1,139
Students' interests	1,15	1,188
…		
Technology	,31	,987
Chemical reactions	,30	1,002
Energy	,26	,994
Matter / particle concept	,20	,959
Zoology	,19	,933
Terminology	,17	1,145
Mathematics	,15	,856
Curriculum framework	,15	1,035
Astronomy / space system	,11	,984
Botany	-,06	,979

Table 15: Highest and lowest priority-practice difference means.

It can be seen in a first view that only the category “Botany” is perceived by the participants as positively implemented when compared to the priority assessment (mean value = -0,6). All the other categories show negative differences (which means they have a positive difference value), although small ones.

The following tables show once again a comparison of the mean values of the different sample groups and the respective significance values (test with and independent sample T-Test) regarding the comparisons of the mean values in the different sample groups. The previous constraints apply once again.

Only the significant test values indicating statistically significant differences are displayed. The tables are divided into different parts according to the different parts of the category system: contexts, motives and situations (Table 16), basic concepts and topics (Table 17), fields and perspectives (Table 18), qualifications (Table 19) and methods (Table 20).

Categories regarding contexts, motives and situations	Group	Sig. Values	Mean values	Std. Deviation
Education / general pers. development	Students	**.003**	,65	,745
	Teachers		,84	1,322
Emotional personality development	Students	-	,65	1,137
	Teachers		,66	1,153
Intellectual personality development	Students	**.011**	1,05	,887
	Teachers		1,03	,897
Students' interests	Students	-	1,10	1,165
	Teachers		1,22	1,237
Curriculum framework	Students	-	,00	1,124
	Teachers		,22	1,008
Out-of-school learning	Students	**-**	,90	1,294
	Teachers		,88	1,157
Media / current issues	Students	-	,50	1,318
	Teachers		,59	1,043
Nature / natural phenomena	Students	**-**	,35	,875
	Teachers		,53	,950
Medicine / health	Students	-	,85	1,040
	Teachers		,56	,914
Technology	Students	-	,30	,923
	Teachers		,25	,950
Everyday life	Students	**-**	,50	,889
	Teachers		,88	,976
Society / public concerns	Students	**.041**	,85	,988
	Teachers		,91	,856
Global references	Students	**.003**	,20	,834
	Teachers		,78	,941
Occupation / career	Students	**<.001**	1,10	1,483
	Teachers		,91	1,304
Science - biology	Students	-	,60	1,188
	Teachers		,47	,671
Science - chemistry	Students	**-**	,35	,933
	Teachers		,78	,941
Science - physics	Students	**-**	,20	1,105
	Teachers		,78	1,039
Science - interdisciplinarity	Students	**.001**	1,00	1,170
	Teachers		1,28	1,276

Table 16: Mean and significance values regarding the priority-practice difference between groups concerning contexts, motives and situations.

Categories regarding basic concepts and topics	Group	Sig. Values	Mean values	Std. Deviation
Matter / particle concept	Students	-	-,05	,826
	Teachers		,41	,946
Structure / function / properties	Students	-	,00	,918
	Teachers		,41	,911
Chemical reactions	Students	**-**	,15	,813
	Teachers		,44	1,105
Energy	Students	-	,35	1,089
	Teachers		,22	,941
System	Students	-	,50	1,100
	Teachers		,41	,911
Interaction	Students	-	,25	1,118
	Teachers		,47	1,077
Development / growth	Students	**.015**	,80	1,399
	Teachers		,56	,914
Models	Students	-	,55	1,146
	Teachers		,59	,837
Terminology	Students	**-**	,10	1,252
	Teachers		,22	1,099
Scientific inquiry	Students	**.043**	,75	1,410
	Teachers		1,22	1,289
Limits of scientific knowledge	Students	**.025**	1,10	1,294
	Teachers		1,06	1,076
Cycle of matter	Students	-	,40	1,046
	Teachers		,41	,979
Food / nutrition	Students	-	,90	,641
	Teachers		,75	1,270
Health / medicine	Students	**<.001**	,85	,875
	Teachers		,59	1,132
Matter in everyday life	Students	**.025**	,55	,826
	Teachers		1,00	1,107
Environment	Students	-	,55	1,099
	Teachers		,47	1,191
Industrial processes	Students	**.027**	,80	1,056
	Teachers		,78	1,008
Safety and risks	Students	**.037**	,95	1,317
	Teachers		,56	1,134
Occupations / occupational fields	Students	**.003**	,90	1,165
	Teachers		,72	,772

Table 17: Mean and significance values regarding the priority-practice difference between groups concerning basic concepts and topics.

Categories regarding fields and perspectives	Group	Sig. Values	Mean values	Std. Deviation
Botany	Students	-	-,10	,641
	Teachers		,06	1,105
Zoology	Students	-	,00	,725
	Teachers		,28	1,054
Human biology	Students	-	,35	,933
	Teachers		,44	,914
Genetics / molecular biology	Students	**.002**	,80	,834
	Teachers		,75	,916
Microbiology	Students	**.004**	,75	,786
	Teachers		,59	,946
Evolutionary biology	Students	**.006**	,80	1,152
	Teachers		,59	1,103
Neurobiology	Students	**.005**	1,00	,973
	Teachers		1,13	1,040
Ecology	Students	-	,65	,745
	Teachers		,75	1,047
Gereral and inorganic chemistry	Students	-	,50	,688
	Teachers		,59	,979
Organic chemistry	Students	-	,70	,733
	Teachers		,47	,950
Analytical Chemistry	Students	-	,60	,995
	Teachers		,72	1,114
Biochemistry	Students	**.001**	1,20	1,281
	Teachers		1,19	1,176
Thermodynamics	Students	**-**	,20	1,056
	Teachers		,56	,914
Electrodynamics	Students	**.050**	,30	1,129
	Teachers		,78	1,039
Mechanics	Students	**-**	,30	,801
	Teachers		,72	,851
Atomic / nuclear physics	Students	-	,30	1,081
	Teachers		,59	,979
Astronomy / space system	Students	-	,10	,912
	Teachers		,16	1,051
Earth sciences	Students	-	,45	,826
	Teachers		,63	,833
Mathematics	Students	**<.001**	,05	,826
	Teachers		,25	,880
Interdisciplinarity	Students	**.016**	1,00	1,522
	Teachers		1,50	1,164
Current scientific research	Students	**.038**	1,40	1,314
	Teachers		1,19	1,281
Consequences of technological developments	Students	-	,95	1,146
	Teachers		1,00	1,414
History of the sciences	Students	**.011**	,65	,933
	Teachers		,72	1,326
Ethics / values	Students	-	1,50	1,357
	Teachers		,94	1,458

Table 18: Mean and significance values regarding the priority-practice difference between groups concerning fields and perspectives.

Categories regarding qualifications	Group	Sig. Values	Mean values	Std. Deviation
Motivation and interest	Students	-	1,10	1,210
	Teachers		1,22	1,211
Critical questioning	Students	**.028**	1,20	1,436
	Teachers		1,13	1,212
Acting reflectedly and responsibly	Students	**.016**	1,00	1,556
	Teachers		1,34	1,181
Knowledge about science-related occupations	Students	**.001**	,40	1,231
	Teachers		1,00	1,295
Specialized knowledge	Students	**.008**	,55	,945
	Teachers		,56	1,162
Comprehension / understanding	Students	-	1,05	1,191
	Teachers		1,22	1,289
Applying knowledge, thinking creatively / abstractly	Students	**.001**	1,40	1,465
	Teachers		1,47	1,436
Judgement /opinion-forming / reflection	Students	**.002**	1,35	1,531
	Teachers		1,25	1,586
Finding information	Students	**.002**	,60	1,231
	Teachers		1,06	1,190
Reading comprehension	Students	**.019**	,65	1,268
	Teachers		,91	,928
Communication skills	Students	**.027**	,80	1,436
	Teachers		,91	1,201
Social skills / teamwork	Students	**-**	,85	1,182
	Teachers		1,16	1,273
Empathy / sensibility / emotional skills	Students	**.027**	,80	1,240
	Teachers		,91	1,254
Perception / awareness / observation	Students	**.032**	,90	1,021
	Teachers		,84	,987
Formulating scientific questions / hypotheses	Students	**.015**	,85	1,565
	Teachers		1,28	1,373
Experimenting	Students	**-**	,90	1,410
	Teachers		1,09	1,058
Analysing / drawing conclusions	Students	**.017**	1,10	1,210
	Teachers		1,19	1,120
Working self-dependently / structuredly	Students	**.028**	1,20	1,196
	Teachers		1,22	1,039

Table 19: Mean and significance values regarding the priority-practice difference between groups concerning qualifications.

Categories regarding methods	Group	Sig. Values	Mean values	Std. Deviation
Cooperative Learning	Students	-	,65	,988
	Teachers		1,09	1,027
Learning in mixed-aged classes	Students	-	,60	,883
	Teachers		,75	1,270
Interdisciplinary learning	Students	**.026**	1,05	1,234
	Teachers		1,25	1,244
Inquiry-based science learning	Students	**.009**	1,00	1,257
	Teachers		1,13	1,362
Learning at stations	Students	-	,10	1,334
	Teachers		,84	1,322
Role play	Students	**.042**	,75	,967
	Teachers		,97	,967
Discussion / debate	Students	-	,75	,967
	Teachers		1,03	1,031
Using new media	Students	**.034**	,35	,671
	Teachers		,75	1,320

Table 20: Mean and significance values regarding the priority-practice difference between groups concerning methods.

5.2 Results part II

5.2.1 Numbers of completed form sheets concerning part II of the questionnaire

In order to identify concepts regarding science education that are considered important, the participants were in part II of round 2 asked to combine from the given set of 80 categories those categories that seem especially important to them *in their combination*. The results of the hierarchical cluster analyses are based on the form sheets which the participants were asked to fill out in the second part of the questionnaire.
None of our 54 participants have filled more than one combinations although we asked them too.

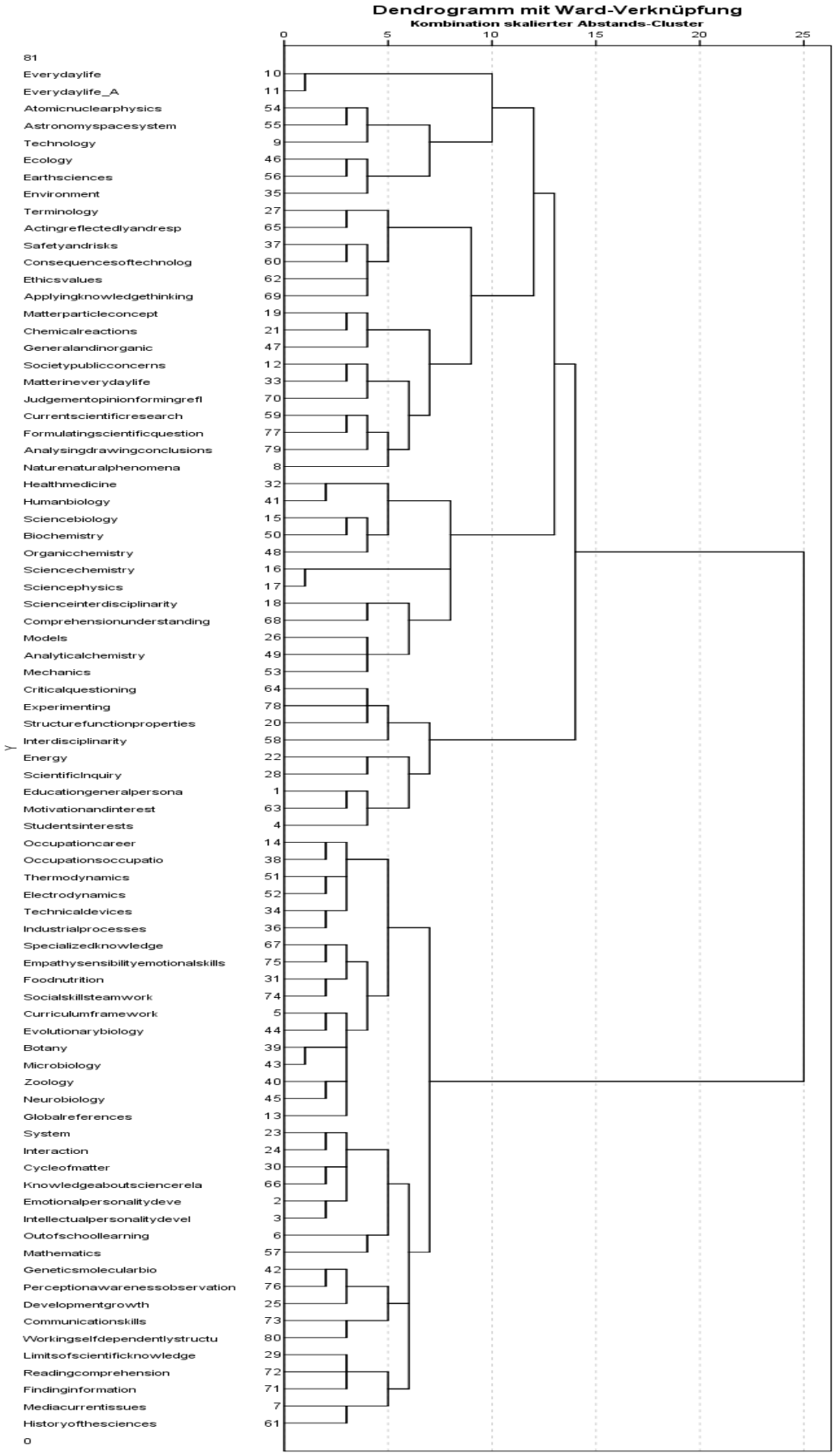
5.2.2 – Hierarchical cluster analysis

The identification and content-related profiling of conceptions about desirable science education was based on hierarchical cluster analyses of the data of the total sample collected in the second part of round two and took place in several consecutive steps.

Despite the caracteristics of the sample (small size) and the questionnaire (large number of items), the clustering solution presents itself as quite clear. It should be noted that for the second form, there were 2 dropouts, and every participant only completed 1 sheet (N = 54).
Furthermore, the analysis included only the categories that were part of the Interim Report, disregarding basic subject-based contexts and disciplines.

5.2.2.1 – Clustering on the bases of the different categories

In the first step of the cluster analytical procedure, structurally similar responses were gradually summarized – first into smaller, then subsequently into larger clusters – as is typical of the HCA procedure. After excluding solutions featuring extremely small or large clusters and after considering aspects of content and coherence, a two-cluster solution rendered the best possible result. The dendrogram presented shows the steps of clustering the categories in the course of the hierarchical cluster analysis.


Dendrogramm mit Ward-Verknüpfung
Kombination skalierter Abstands-Cluster
0
5
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Everydaylife 10
Everydaylife_A 11
Atomicnuclearphysics 54
Astronomyspacesystem 55
Technology 9
Ecology 46
Earthsciences 56
Environment 35
Terminology 27
Actingreflectedlyandresp 65
Safetyandrisks 37
Consequencesoftechnolog 60
Ethicsvalues 62
Applyingknowledgethinking 69
Matterparticleconcept 19
Chemicalreactions 21
Generalandinorganic 47
Societypublicconcerns 12
Matterineverydaylife 33
Judgementopinionformingrefl 70
Currentscientificresearch 59
Formulatingscientificquestion 77
Analysingdrawingconclusions 79
Naturenaturalphenomena 8
Healthmedicine 32
Humanbiology 41
Sciencebiology 15
Biochemistry 50
Organicchemistry 48
Sciencechemistry 16
Sciencephysics 17
Scienceinterdisciplinarity 18
Comprehensionunderstanding 68
Models 26
Analyticalchemistry 49
Mechanics 53
Criticalquestioning 64
Experimenting 78
Structurefunctionproperties 20
Interdisciplinarity 58
Energy 22
ScientificInquiry 28
Educationgeneralpersona 1
Motivationandinterest 63
Studentsinterests 4
Occupationcareer 14
Occupationsoccupatio 38
Thermodynamics 51
Electrodynamics 52
Technicaldevices 34
Industrialprocesses 36
Specializedknowledge 67
Empathysensibilityemotionalskills 75
Foodnutrition 31
Socialskillsteamwork 74
Curriculumframework 5
Evolutionarybiology 44
Botany 39
Microbiology 43
Zoology 40
Neurobiology 45
Globalreferences 13
System 23
Interaction 24
Cycleofmatter 30
Knowledgeaboutsciencerela 66
Emotionalpersonalitydeve 2
Intellectualpersonalitydevel 3
Outofschoollearning 6
Mathematics 57
Geneticsmolecularbio 42
Perceptionawarenessobservation 76
Developmentgrowth 25
Communicationskills 73
Workingselfdependentlystructu 80
Limitsofscientificknowledge 29
Readingcomprehension 72
Findinginformation 71
Mediacurrentissues 7
Historyofthesciences 61
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5.2.2.2 – Cluster-analytically identified conceptions regarding desirable science education

As the clusters in our dendrogram cannot be interpreted to identify concepts of science education, we will draw on the FUB results.
Following we present the results of the cluster analyses obtained by the FUB team and we will use the concepts developed by the FUB team (Schulte & Bolte, 2012).

Cluster A	Cluster B	Cluster B
• Emotional personality development • Media / current issues • Global references • Empathy / sensibility • Perception / awareness / observation • History of the sciences • Out-of-school learning • Curriculum framework • Communication skills • Reading comprehension • Finding information • Social skills / teamwork • Occupations / occupational fields • Knowledge about science-related occupations • Occupation / career • Earth sciences • Industrial processes • Cycle of matter • Development / growth	• Intellectual personality development • Science - interdisciplinarity • Interdisciplinarity • Current scientific research • Scientific inquiry • Critical questioning • Rational thinking / analysing / drawing conclusions • Applying knowledge / creative and abstract thinking • Factual knowledge • Formulating scientific questions / hypotheses • Terminology • Matter / particle concept • Structure / function / properties • Chemical reactions • Experimenting • Models • Limits of scientific knowledge • Technology • Technical devices • System • Interaction • Energy • Mathematics	• Education / general personality development • Students' interests • Motivation and interest • Everyday life • Society / public concerns • Nature / natural phenomena • Comprehension / understanding • Acting reflectedly and responsibly • Judgement / opinion-forming / reflection • Ethics / values • Food / nutrition • Health • Medicine • Matter in everyday life • Environment • Consequences of technol. developments • Safety and risks • working self-dependently / structuredly / precisely
n_{cat} = 19 n_{cases} = 494 $n\%_{cases}$ = 15,6%	n_{cat} = 23 n_{cases} = 1347 $n\%_{cases}$ = 42,4%	n_{cat} = 18 n_{cases} = 1335 $n\%_{cases}$ = 42,0%

Basic subject-based contexts and disciplines (not included in cluster analysis)			
Subject-based contexts:	Disciplines:		
• Science – biology • Science – chemistry • Science – physics	• Botany • Zoology • Human biology • Genetics / molecular biology • Evolutionary biology	• Neurobiology • Ecology • Microbiology • Inorganic and general chemistry • Organic chemistry • Analytical chemistry	• Biochemistry • Thermodynamics • Electrodynamics • Mechanics • Atomic and nuclear physics • Astronomy / space

Table 23: Distribution of the categories among the clusters of the three-cluster solution

Source: (Schulte & Bolte, 2012).

Cluster-analytically identified conceptions regarding desirable science education
On the basis of the previous considerations, three statistically identified clusters can be rendered into concepts regarding desirable science education. The three concepts are titled and described in the following.

Concept A:
Awareness of the sciences in current, social, globally relevant and occupational contexts relevant in both educational and out-of-school settings
Concept A (Awareness of the sciences in current, social, globally relevant and occupational contexts relevant in both educational and out-of-school settings) refers to an engagement with the sciences within the frame of current, social, globally relevant, occupational and both educational and out-of-school contexts, enhancing emotional personality development and basic skills. The impressions a person gets through engaging with topics and associated science-related questions from his or her environment influence both the person's sensibility and his or her attitudes towards the sciences. Dealing with scientific issues or phenomena in out-of-school or social and public contexts respectively also facilitates conscious experiences of scientific phenomena, scientifically precise observation and cognitive ability. Moreover, basic and professionally relevant skills such as finding, interpreting and communicating information can be enhanced in this way. Suggestions for this kind of engagement and education are amongst others provided e.g. by current issues or media coverage. Dealing with the history of the sciences especially reveals how findings and methods of the sciences enable, enhance and bring forward research in the natural sciences. This shows moreover how historical science-related developments are still linked to applications in industry and technology, how these applications changed the world and how they influence our professional and everyday life.
The cluster analytical calculations of concept A lead to the grouping of the following categories:

Situations, contexts, motives:
Emotional personality development, Media / current issues, Global references, Occupation / career, Out-of-school learning, Curriculum framework

(Basic) concepts, themes and perspectives:
History of the sciences, Occupations / occupational fields, Industrial processes, Cycle of matter, Earth sciences, Development / growth

Qualifications:
Empathy / sensibility, Perception / awareness / observation, Social skills / teamwork, Knowledge about science-related occupations, Communication skills, Finding information (Schulte & Bolte, 2012).

Concept B: Intellectual education in interdisciplinary scientific contexts

Concept B (Intellectual education in interdisciplinary scientific contexts) refers to an engagement with the sciences, their terminology, their methods, their basic concepts, their interdisciplinary relations, their findings and their perspectives, which enhance individual intellectual personality development. Dealing with the sciences serves in this course not only the acquisition of science-related basic knowledge but also helps to understand fundamental findings and the process of gaining knowledge in the sciences. Moreover, dealing with questions and topics of the sciences helps to comprehend and follow (empirical and experimental) scientific research methods, facilitates analytical abilities and fosters the ability to take differentiated perspectives. In addition, an engagement with current scientific research reveals not only how findings and methods of the sciences enable, enhance and support both scientific research and its applications, but also how scientific research is interconnected interdisciplinarily.

The cluster analytical calculations of concept B lead to the grouping of the following categories:

Situations, contexts, motives:

Intellectual personality development, Science - interdisciplinarity, Technology

(Basic) concepts, themes and perspectives:

Interdisciplinarity, Scientific inquiry, Current scientific research, Limits of scientific knowledge, Terminology, Matter / particle concept, Structure / function / properties, Chemical reactions, Models, Technical devices, System, Interaction, Energy, Mathematics

Qualifications:

*Applying knowledge / creative and abstract thinking, Formulating scientific questions / hypotheses, Factual knowledge, Critical questioning, Analysing / drawing conclusions, Experimenting (*Schulte & Bolte, 2012).

Concept C:
General science-related education and facilitation of interest in contexts of nature, everyday life and living environment
Concept C (General science-related education and facilitation of interest in contexts of nature, everyday life and living environment) refers to a science-related engagement with everyday life and living environment issues that takes up and promotes students' interests, enhancing general personality development and education. In this way, aspects such as opinion-forming and acting reflectedly and responsibly are particularly important. Dealing with topics from the natural and technological living environment shows how scientific research, scientific applications and scientific phenomena influence both public and personal life. Another important aspect of this concept is engaging with different values and perspectives as well as reflecting on both personal and public deliberations and course of action. Moreover, this concept refers to facilitating the motivation for scientific inquiry beyond school, including aspects such as realizing and shaping one's own interests. Dealing with scientific issues and phenomena within the contexts of social and public fields such as technological developments, their consequences and issues about safety and risks enhances in particular the students' own abilities to judge and both critically reflect and rationally account for their own actions.
The cluster analytical calculations of concept C lead to the grouping of the following categories:

Situations, contexts, motives:
Society / public concerns, Students' interests, Education / general personality development, Nature / natural phenomena, Everyday life, Medicine

(Basic) concepts, themes and perspectives:
Safety and risks, Consequences of technological developments, Ethics / values, Food / nutrition, Health, Matter in everyday life, Environment

Qualifications:

> ***Acting reflectedly and responsibly, Judgement / opinion-forming / reflection, Motivation and interest, Comprehension / understanding, working self-dependently / structuredly / precisely (***Schulte & Bolte, 2012).

6 Discussion

6.1 Discussion part I

The results of the analyses presented in chapter 5.1 show that regarding the *priority assessments* – apart from some exceptions - that the different sample groups generally consider the same categories as relevant and important. However, as the tables also showed, the mean values differ in a number of pair comparisons among the sample groups in a statistically significant way from each other.

Regarding *practice assessments*, the category which presents the largest number of differences concerns is the "Qualifications". It seems this is the area where teachers and students most disagree.

In the part of *priority-practice differences*, our first, special attention will be paid to those aspects that feature particularly large or small differences between the assessments of their priority and their actual realization in educational practice because these extreme difference values inform about especially big or small discrepancy between priority and reality.

The calculated priority-practice differences showed that many categories feature large differences between their priority and practice values.

6.2 Discussion part II

The high variance and low sample size doesn't allow for a – at least at first – interpretable results. More data should be collected in order to construct and interpret concepts concerning desirable science education.

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